



RESEARCH DEPARTMENT

REPORT

Experimental v.h.f. ferrite aerials for car reception

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EXPERIMENTAL V.H.F. FERRITE AERIALS FOR CAR RECEPTION
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Summary

A ferrite aerial unit mounted on the back of a car wing mirror and a ferrite current sensing probe unit intended for car reception are described in this report. The performance of these units has been compared with that of the conventional whip aerial.

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1. Introduction

The whip is the most common form of aerial in use for car reception. It performs well at low and medium frequencies (l.f. and m.f.) and moderately well at very high frequencies (v.h.f.). It is usually mounted on one of the wings of the car in a vertical position. In this position it responds best to vertically-polarized fields and has a reasonably omnidirectional directivity pattern. In the case of horizontally-polarized transmissions it relies on cross-polarized field components for its pick-up; these being produced by propagation depolarization and by the scattering of the horizontally-polarized wave by the car body itself.

The whip aerial has the disadvantage of being physically long, usually about one metre when fully extended, is liable to damage and a temptation to vandals. Its position on the car body can form a visual distraction for the driver. At present, most v.h.f. transmissions are horizontally polarized and improved reception could be expected in rural areas, although not necessarily in urban areas, if a horizontally-polarized receiving aerial were used. However, an omnidirectional horizontally-polarized aerial, which is reasonably well matched over the required bandwidth and constructed from conventional elements, is large and would certainly be more inconvenient to the car user than the vertical whip aerial.

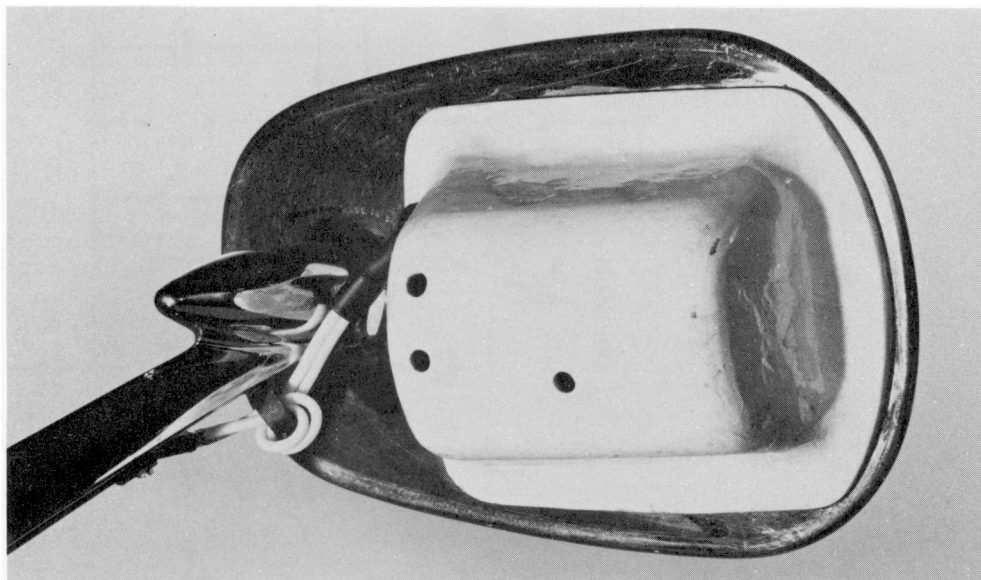
It was thought that a ferrite aerial incorporated in a wing mirror assembly could have advantages. Such a unit has been built and tested. A second idea considered for car reception was to use a ferrite probe unit to sense the magnetic field associated with currents induced in the car body by the incident signals. A probe unit has also been built and tested. It can be mounted inside the car in a selected position, near a window edge or door pillar, where it will be well protected and unobtrusive.

2. The wing mirror aerial unit

A ferrite aerial unit has been built and mounted on the metal backing of a wing mirror. The unit uses the same ferrite rod (Neosid F29) as that used in an experimental ferrite aerial unit for a v.h.f. portable receiver,¹ but the rod has been shortened to an overall length of 50 mm. A three-turn coil is wound on the ferrite rod and is tuned by a varactor diode. A two-turn coupling coil also wound on the rod feeds a two-stage f.e.t. amplifier having an 18 dB voltage gain and capable of working into a 50 Ω load.

The mirror with the unit enclosed in a glass fibre shroud is shown in Figure 1. The circuit diagram is shown in Figure 2.

Fig. 1 - Ferrite aerial unit mounted on wing mirror



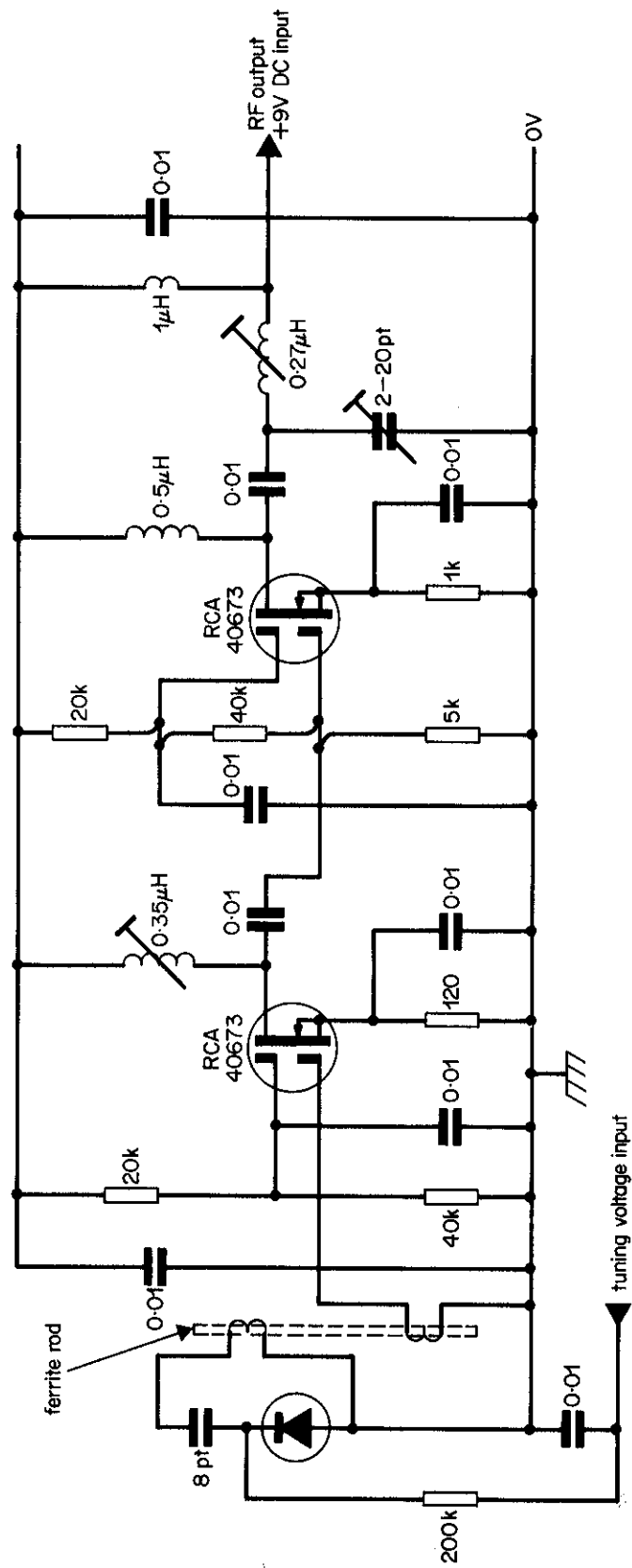


Fig. 2 - Circuit diagram of mirror aerial unit

3. Compatibility with a radio receiver

As the Q of the tuned ferrite aerial is moderately high (about 50) it is necessary for the unit tuning to track with that of the car receiver for optimum results to be obtained. For this purpose a tuning unit has been built in which a probe is used to sample the local oscillator of the receiver. The probe output is amplified and its frequency divided by 20 before it is fed to a discriminator circuit. The latter provides an output dependent on the receiver tuning frequency. The discriminator output is fed through a d.c. amplifier, having a preset gain and offset voltage output, thus allowing the ferrite unit tuning to be controlled and matched to that of the receiver.

4. Directivity patterns of the wing mirror aerial

Initial tests with the mirror mounted on a small metal box showed the horizontal polarization directivity pattern of the unit to be nearly omnidirectional, having a maximum-to-minimum ratio of approximately 2.0 dB. Its measured output signal level was -1 dB relative to the output of a half-wave dipole and it gave at least 13 dB discrimination against vertically-polarized signals.

Measurements made with the mirror mounted

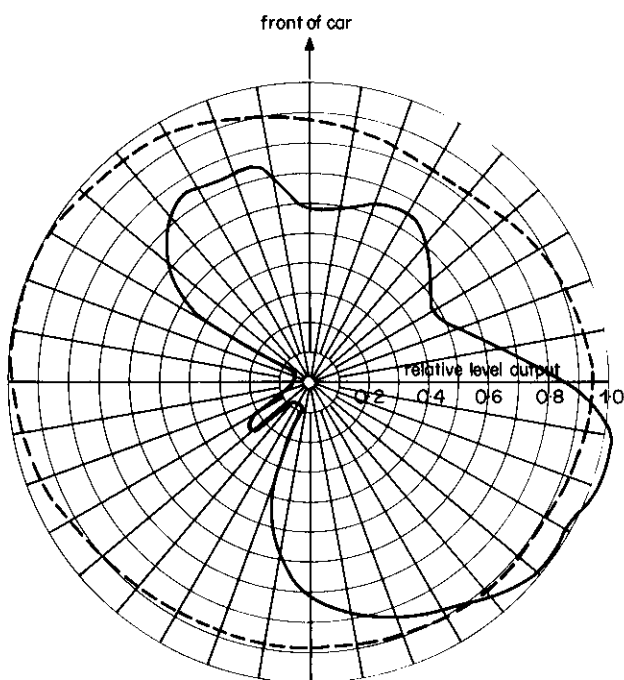


Fig. 3 - Directivity pattern of mirror aerial for horizontal polarization

----- mounted on a metal box
———— mounted on offside wing of an Escort saloon car

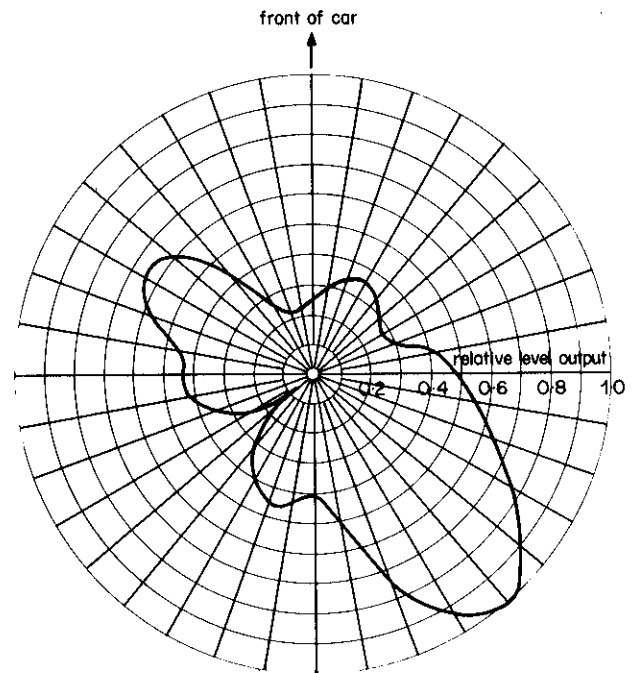


Fig. 4 - Directivity patterns of vertical whip aerial mounted on the offside wing of an Escort saloon car

on the wing of a Ford Escort saloon car showed, as expected, that the presence of the car body caused considerable distortion to the directivity pattern. A comparison of the normalised patterns obtained with reception of Wrotham Radio 2 transmissions is shown in Figure 3. Similar distortion of the directivity pattern occurs at other frequencies in Band II.

For comparison, the directivity pattern of a conventional whip aerial mounted at the same position on the car wing for horizontally polarized signals is shown in Figure 4. This also shows one deep minimum but this is relatively narrow compared with the minima produced by the mirror aerial.

5. The current sensing probe unit

The unit also uses a short ferrite rod and has a similar tuning and coupling circuit arrangement. The unit has a single F.E.T. amplifier giving a 6 dB voltage gain into a 50Ω load. The whole unit is housed in a small cast metal box, one end of which is formed to provide a split screen for the ferrite rod as shown in Figure 5. The tuning voltage was derived as for the wing mirror aerial.

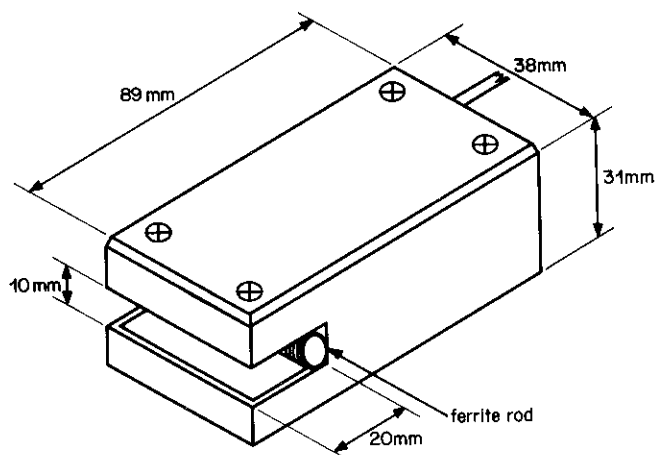


Fig. 5 - Mechanical arrangement of the ferrite rod probe unit in cast metal box

6. Directivity patterns of the probe unit/car combination

The unit was developed to sense the presence of currents induced in the car bodywork. Measurements showed maximum pick-up occurred when the unit was placed close to window edges or door pillars.

Listening trials, using a monophonic receiver

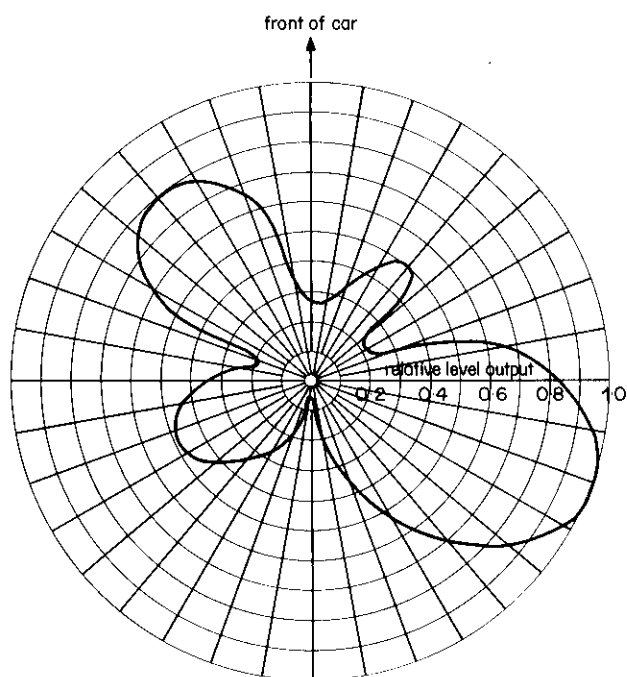


*Fig. 6 - Reception of Radio 2 with probe unit mounted on rear window edge on offside of an Escort saloon car
Horizontal polarization*

with either the probe or whip aerial connected to its input, were carried out whilst driving around the local area. Subjectively, the two aerials appeared to give similar results. Directivity pattern measurements, however, showed the probe/car combination to have poor omnidirectional performance, the sensitivity varying considerably with bearing. Figure 6 shows the directivity pattern obtained with the probe mounted on the central door pillar on the offside of an Escort car, while receiving Wrotham Radio 4 transmission. Figure 7 shows the pattern with the probe unit mounted near the rear window edge on the offside of the car while receiving the Radio 2 transmission. These positions on the car were found by experiment to be the only ones that gave acceptable results.

7. Conclusions

Neither the mirror aerial, nor the probe unit, showed any improvement in performance over that of the conventional whip aerial, even when horizontally polarized transmissions are involved. It can be concluded that the added complexity of these ferrite aerial systems does not favour their use unless great importance is ascribed to compactness or unobtrusiveness. It is almost certain that v.h.f. transmissions will, eventually,

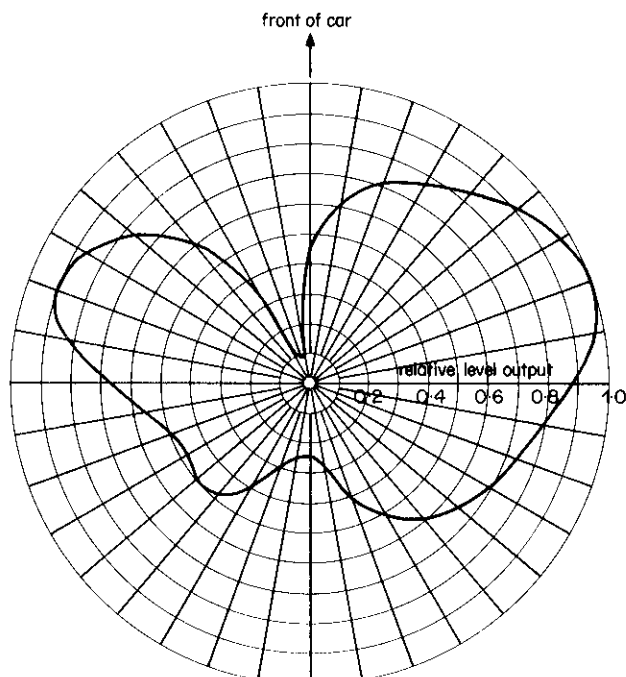


*Fig. 7 - Reception of Radio 4 with probe unit mounted on central window pillar on offside of an Escort saloon car
Horizontal polarization*

include a vertically polarized field component. This will have the added advantage of higher field strength at the vehicle whip aerial height and give improved whip aerial directivity patterns. The need for a specifically horizontally-polarized car aerial will then disappear.

8. Reference

1. THODAY, R.D.C. 1977. A Band II ferrite aerial unit for portable receivers. Research Department Report No. 1977/11.